

ART X.—*Observed Variations in the Dip of the Horizon.*

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The observations recorded in the table herewith were made with a 12 inch Theodolite, by Troughton & Simms, reading by verniers to 10". The elevation of the horizontal axis was 132 feet above mean sea level as determined by spirit levelling, and a few days tide gauging the range of tide observed varying from 6' 6" to 10'. The station was (approximately) in latitude 38° 22' S. Longitude 144° 46' E., and the observations were taken in part by the writer and in part by engineering students of the Melbourne University. From the instrument station good views could be obtained to the south over part of Bass Strait (average depth about 35 fathoms), and to the north over part of Port Phillip Bay (average depth about 5 fathoms) as well as to Arthur's Seat, distant 9 nautical miles to the eastward, and elevated 996 feet above mean water level of Port Phillip Bay as determined by spirit levelling. The angles of elevation were taken to a point on the look-out tower 20 feet above the summit, or 1016 feet above mean water level of Port Phillip Bay.

The observations were taken during very hot weather, when the difference between air and sea temperatures was large. The sea temperature to the south (in Bass Strait) was about 67°, that to the north (in Port Phillip Bay) was not observed, but, no doubt was higher.

The normal dip under average temperature and pressure would be 0° 11' 20" as against the maximum and minimum observed of 0° 21' 35" and 0° 5' 5" respectively. Reference may be made to "Raper's Navigation," pages 61 and 194, for further observations on this point.

The altitude of point sighted to on Arthur's Seat, according to the smallest observed angle, is 1003 feet; according to the largest observed angle 1043 feet; and according to the mean angle 1031

feet as against 1016 feet as determined by spirit levelling. These altitudes are computed with co-efficient of refraction = 0.083. Using the lower values quoted by American writers these altitudes would be increased by two feet. Reference may be made to Appendix XVI. "U.S. Coast and Geodetic Survey Report for 1876" for interesting information about somewhat similar observations. The American observations, as well as the writer's, give for observations taken from the lower station a difference of elevation greater than the true one. This can be explained on the assumption that the path of the ray between the stations is not a circular curve but one whose radius of curvature is greater at the higher station than at the lower one. As the air is denser at the lower station this is to be expected.

Attention may be directed to the remarkably small variations in the observed angles of elevation to Arthur's Seat compared with the large variations in the dip of the horizon.

The observations support the following deductions, which are not however advanced as new :—That under abnormal conditions the dip may differ greatly from the ordinary tabular value, that it may be unequal in different parts of the horizon, and that it may vary very rapidly especially in the afternoon. That at comparatively moderate angles of elevation the abnormal refraction is greatly diminished and that under unfavourable conditions of the atmosphere, altitudes determined by angles of *elevation* of about one degree observed from moderate distances are quite as reliable as elevations determined from a few barometric observations.

OBSERVED DIPS, ETC.

Date.	Time.	Air Temp.	Watkin Aneroid.	Dip South.	Dip North.	Elevation Arthur's Seat.	Remarks.
Feb. 12	3.45 p.m.	93.8	29.958	0 9 15	0 11 0	0 53 5	Instrument normal.
	4.15 p.m.	93.8	29.955	0 7 37½	0 13 35	0 53 0	Instrument reversed.
	5 p.m.	94.3	29.943	0 8 55	8 8 45	0 53 25	Instrument normal.
	5.15 p.m.	92.5	29.938	0 11 25	0 9 25	Covered with haze	Instrument reversed.
	9.40 a.m.	82.8	30.061	0 8 40	0 8 50	0 52 40	Instrument normal.
	10.15 a.m.	84.4	30.052	0 8 50	0 8 15	0 52 10	Instrument reversed.
	12.15 p.m.	91.8	30.033	0 7 30	0 5 5	0 52 45	Instrument normal.
	12.30 p.m.	92.4	30.032	0 7 25	0 5 25	0 52 55	Instrument reversed.
	3.15 p.m.	96.7	30.008	0 21 35	0 8 55	0 51 5	{ Inst. normal. Temp. when sighting to A. Seat 88°
	3.25 p.m.	82.0	30.008	Covered	with haze	0 53 35	{ Instrument reversed.
14	4 p.m.	81.0	30.008	0 11 30	Covered	with haze	{ Inst. normal. Cool S. wind. Hazy.
	3 p.m.	88.4	22.920	Haze	0 7 30	Haze	Instrument normal.
		81.8	29.910	Haze	0 9 25	Haze	Instrument reversed.
17	12 noon	86.0	29.540	0 9 30	0 9 50	0 53 15	{ Instrument normal. North wind. No sun.
		86.0	22.540	0 10 10	0 9 30	0 53 0	{ Instrument reversed. North wind. No sun.
March 1	10.45 a.m. 11 a.m.	69.0	29.919	0 12 5	0 12 5	0 52 50	Instrument normal.
		69.0	29.919	0 10 15	0 11 45	0 53 5	Instrument reversed.